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**UIC#1 CLOSURE
REPORT**

Lakeside Industries, Inc.
4850 NW Front Avenue
Portland, Oregon

June 13, 2004

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1.0 SUMMARY OF FINDINGS

Site investigation activities were conducted at the Lakeside Industries, Inc. facility in Portland, Oregon to evaluate subsurface impacts to soil and groundwater relating to releases from a decommissioned drywell, i.e. Underground Injection Control system #1 (UIC#1). In October 2003, four push probe borings were installed for the collection of soil and groundwater samples. In February 2004, two groundwater monitoring wells were installed and sampled. A summary of the findings relating to the investigation activities is presented below.

- Diesel-type petroleum hydrocarbons [up to 1,065 parts per million (ppm)] and low levels of polynuclear aromatic hydrocarbons (PAHs) were found to be present within soils of the UIC#1 drainfield between depths of 4.5 and 12 feet below ground surface (bgs).
- Petroleum hydrocarbon concentrations found in native silty soils immediately below the drainfield attenuate very rapidly, declining to less than 30 ppm within one foot, indicating the petroleum impacts in soil are primarily limited to the drainfield.
- Diesel-type petroleum hydrocarbons and low levels of toluene and PAHs were detected in the water perched within the UIC#1 drainfield between depths of 8 and 12 feet bgs.
- PAHs were not detected in a sample collected from uppermost perennial groundwater within native alluvial deposits at a depth 28 feet bgs immediately down-gradient of the drainfield, indicating petroleum impacts appear to be limited to perched water in the drainfield.
- Risk evaluation did not identify the presence of current or reasonably likely future unacceptable risks to human health or ecological receptors resulting from the petroleum impacts to soil and perched water relating to the former UIC#1 at the subject property.
- Further evaluation of impacts at UIC#1 do not appear necessary, and administrative closure of this UIC appears warranted.
- If left in-place undisturbed, no actions are necessary with respect to the impacted soils and water. However, if petroleum-contaminated soil or water is encountered during future site development activities, special management of the material will be necessary for removal and/or disposal purposes.

2.0 INTRODUCTION

In September 2003, Lakeside Industries, Inc. (Lakeside Industries) retained HAI to conduct Underground Injection Control (UIC) decommissioning activities at their facility. Lakeside Industries indicates two UIC devices (drywells), UIC#1 and UIC#2, were located on-site. The report herein discusses the decommissioning and subsequent investigation activities completed at UIC#1. Decommissioning activities for UIC#2 are documented in a separate UIC Closure Report (HAI 2004) that was previously submitted to the Oregon Department of Environmental Quality (DEQ) for review.

The Lakeside Industries facility, located at 4850 NW Front Avenue in Portland, Oregon, is situated adjacent to the Willamette River and Portland Harbor Superfund site (Portland Harbor). In 2001, Lakeside Industries completed a Preliminary Site Assessment (PSA) (HAI 2001) of the property to evaluate the site as a potential contributor of sediment contamination in the Portland Harbor. The PSA eliminated the subject property as a source of contamination found in Willamette River sediments adjacent to and downstream of the site. Furthermore, the PSA discussed the presence of the two subject drywells at the facility. The UIC decommissioning activities were conducted at DEQ's request to assess whether the UICs were potential sources of contamination.

3.0 BACKGROUND

3.1 Site Description

The Lakeside Industries site is located at 4850 NW Front Avenue in Portland in Multnomah County, Oregon (Figure 1). The site encompasses approximately 9.41 acres of uplands on two tax lots, 1N1E19A-00600 and 1N1E19A-00700, in the northeast quarter of Section 19 in Township 1 North, Range 1 East (T1N, R1E) of the Willamette Meridian (WM). The site is situated in an industrial area along the west bank of the Willamette River.

The surrounding land uses include the following:

- To the northeast of the site is the Willamette River

- To the northwest of the site is a municipal storm sewer outfall, beyond which is Shaver Transportation, a shipping company
- To the southwest is Front Avenue, beyond which is Oncorp America Inc., a building materials wholesaler
- To the southeast is a materials storage yard for Gunderson, Inc. (Gunderson), a railcar manufacturer.

Lakeside industries has operated a hot-mix asphalt plant at the subject site since 1987. There are three buildings onsite: 1) an office building and maintenance shop; 2) a control house for the conveyor system that is located adjacent to the dock; and 3) a control house for the hot-mix asphalt plant (Figure 2). Other structures include three overhead conveyor systems; a dock; a reclaimed asphalt pavement (RAP) crushing and conveyor system; a former vehicle wash rack; a 15,000-gallon above-ground tank (AST) containing diesel fuel and two associated fuel dispensers; the hot-mix asphalt plant; a multiple chambered baghouse for particulate from the asphalt processor; short-term storage silos; and a cement-treated base processor, a specialty product produced infrequently. There are also 5 groundwater monitoring wells installed onsite to evaluate a groundwater contaminant plume originating at the adjacent Gunderson property.

An approximate 200-gallon poly-tote of surfactant is stored and used at the former wash rack. The surfactant is used to coat the inside of the box on dump trucks before loading in asphalt to reduce the likelihood of asphalt adhering to the inside of the box. This process is referred to as 'soaping'. In addition, there are two poly tanks that contain non-hazardous liquid additives for the hot-mix asphalt; which are located beneath the mixer in a paved area.

None of the materials stored on-site that are exposed to the environment (including the aggregate, the hot-mix asphalt, or the RAP), aside from the diesel fuel that is in a containment structure, are considered to be hazardous materials.

3.2 UIC#1 Description

UIC#1 is located in the vicinity of the diesel fueling area and soaping area (Figure 3). Prior to the decommissioning of UIC#1, surface runoff from the paved areas around and beneath the fueling and soaping area, as well as from the diesel tank containment, was noted to flow, as a result of sloping of

pavement and shallow channels, to a catch basin, then to an oil/water separator, and then reportedly into UIC#1. Lakeside Industries indicated both the catch basin and the oil/water separator were cleaned as needed, typically once or twice annually to reduce the likelihood of petroleum hydrocarbons entering the drywell through the runoff. In April 2003, the stormwater discharge into UIC#1 was terminated and redirected from the oil/water separator to flow to the municipal storm sewer system located along NW Front Avenue (Figure 2).

UIC#1 was constructed of a 23-foot long below ground PVC pipe (un-perforated) that discharged into a gravel drainfield. The gravel drainfield, composed of 3-inch to 5-inch minus rounded river rock, measured approximately 40 feet by 30 feet by 11 feet deep. The PVC pipe discharged into the southern end of the drainfield at a depth of approximately 4.4 feet below ground surface (bgs).

On September 30, 2003, UIC#1 was decommissioned by the removal of the PVC pipe with an excavator. An exploratory trench was excavated within the gravel drain field at the pipe discharge location to a depth of 8 feet below ground surface (bgs). The excavation was halted due to the failure (i.e., cave in) of the excavation sidewalls. The decommissioning activities at UIC#1 and UIC#2 are documented in the UIC Release Report (HAI 2003).

3.3 Site History

Lakeside Industries operates a hot-mix asphalt plant, first opened in 1987, at 4850 NW Front Avenue, Portland, Oregon, and is located in a heavily industrial area of the city along the west bank of the Willamette River.

The property has been developed since the early 1940s, first as a general construction yard until the early 1970s, and then as a portion of the adjacent Gunderson property storage yard and possibly warehousing until 1987 when it was redeveloped as a hot-mix asphalt plant. As indicated in the PSA (HAI 2001), groundwater beneath the site is impacted with halogenated volatile organic compounds (HVOCs) from the adjacent Gunderson property. For further details regarding site history, please see Section 4 of the PSA (HAI 2001).

3.4 Environmental Setting

A discussion of topography, surface water hydrology, regional and site geology and hydrogeology, and surrounding sensitive environments is presented below.

3.4.1 Topography

The topography of the site and surrounding properties is relatively flat with a slight slope to the northeast, with the northeastern portion of the property sloping northeast toward the Willamette River (Figure 1). The elevation of the site ranges from approximately 38 feet above mean sea level (msl) (City of Portland datum) near NW Front Avenue to about 34 feet msl near the Willamette River. The northeastern portion of the property slopes steeply down to the river at about 10 feet msl.

3.4.2 Surface Water Hydrology

The northeastern property boundary is adjacent to the Willamette River (Figure 1). Stormwater from paved portions of the site (i.e., sheet flow) is collected into catch basins and passes through an oil water separator prior to emptying into the municipal stormwater system located south of the site at NW Front Avenue. Stormwater in unpaved areas is infiltrated into the ground or landscaped areas on-site (Figure 1). No ditches or other storm water conveyance systems are located on-site.

3.4.3 Regional and Site Geology

The area geology presented here is based on extensive investigations conducted at the adjacent Gunderson site. Excerpts from various Gunderson reports, including well logs for the five Gunderson monitoring wells installed on the Lakeside Industries property, are included in Appendix A.

The geologic units at and in the vicinity of the site can be subdivided as follows, from youngest to oldest:

- Fill Unit
- Alluvial Deposits – Sand/Silt Unit

- Alluvial Deposits – Gravel Unit
- Columbia River Basalt Group

The oldest and lowermost geologic unit of interest beneath the site consists of the Columbia River Basalt Group. The Miocene-age Columbia River Basalt, composed of a series of individual lava flows, generally forms the base (bedrock) of the Portland Basin and outcrops to the southwest of the site in the Tualatin Mountains. Overlying the basalts are Quaternary-age Alluvial Deposits, composed of two primary units. The lowermost unit, which immediately overlies the basalts and weathered basalts at most locations, is composed of unconsolidated gravels of apparent alluvial origin (the Gravel Unit). Overlying the gravels are unconsolidated sands, silts, and occasional clays (the Sand/Silt Unit). Overlying the Alluvial Deposits at many locations along the river is a Fill Unit.

The well log for Gunderson well MW-46 (the well located closest to UIC#1 that is now decommissioned) indicates loose sand fill to a depth of 7 feet bgs, and a soft silty sand (likely fill) to a depth of 12 feet bgs (the Fill Unit). Stiff silt and occasional sand extend from 12 to 42 feet bgs (the Sand/Silt Unit). Beneath the Sand/Silt Unit, a Gravel Unit, composed of basalt cobbles and gravels in sand, is present to a depth of 50.5 feet bgs, where the Columbia River Basalt was encountered. A copy of well log for MW-46 is included in Appendix A, and the well's location is shown in Figure 2.

3.4.4 Site Hydrogeology

Uppermost groundwater beneath the site is present in the Sand/Silt Unit of the Alluvial Deposits. Of the five Gunderson monitoring wells installed at the Lakeside Industries site, three wells (MW-43, MW-44, and MW-46) are screened in the Gravel Unit just above basalt bedrock at depths between 47 to 61 feet bgs (Appendix A). The other two wells (MW-50 and MW-51) are screened in the lower portion of the Sand/Silt Unit at depths between 36 and 50 feet bgs. As measured in the five Gunderson monitoring wells located on the property, groundwater levels vary by up to 7.5 feet seasonally, at depths ranging from 21 to 33 feet bgs (5.8 to 13.7 feet msl).

Groundwater flow direction within the Alluvial Deposits, as reported by the Gunderson reports, is northerly to northeasterly toward the Willamette River. Groundwater within the Alluvial Deposits discharges to the Willamette River.

Occasional seasonal perching of water may occur within the Fill Unit on top of the stiff native silts. This perched water would not discharge directly to the Willamette River, but would percolate downward into the Alluvial Deposits water-bearing zone prior to migrating to the Willamette River.

There are no water wells on the subject property.

3.4.5 Surrounding Sensitive Environments

The properties surrounding the subject property are zoned as industrial. There are no designated riparian corridors, wetlands, wildlife habitat, federal wild and scenic rivers, state scenic waterways, approved Oregon recreation trails, natural areas, wilderness areas, or known cultural areas surrounding the site. The Willamette River borders the northeastern portion of the site.

3.5 Previous Investigations

All previous environmental investigations at the Lakeside Industries site have been previously referred to. There have been no underground storage tank (UST) or leaking underground storage tank (LUST) investigations on-site. These include the HAI (2001) PSA, the UIC Release Report (HAI 2003), the UIC#2 Closure Report (HAI 2004), and the on-site Squire investigations relating to the adjacent Gunderson site (Appendix A). The investigation activities of soil and groundwater conducted at UIC#1 in October 2003 through February 2004 are discussed in this report.

3.6 Conceptual Release, Fate, and Transport Model

From 1987 until April 2003, UIC#1 accepted stormwater from one catch basin that collected surface runoff from the diesel fuel dispenser and soaping area, as well as from water that collected in the diesel fuel tank containment basin. The catch basin discharge passed through an oil water separator prior to discharge at an outfall (drywell) located in the gravel drainfield (i.e., UIC#1) (Figure 3). At the time of decommissioning, a frothy sludge was found in the UIC outfall pipe and within the gravel directly below the outfall. The froth was likely from the surfactant that was used in the soaping area. Analytical testing of the sludge indicates it contained diesel- and oil-type petroleum hydrocarbons, with naphthalene and polynuclear aromatic hydrocarbons (PAHs). Besides naphthalene, no other volatile organic

compounds (VOCs) were detected. Further, metals were not detected at levels of concern.

Based on the preceding, it is concluded the hazardous substances that were released into the gravel drainfield were diesel- and oil-range petroleum hydrocarbons, which contained low levels of PAHs (including naphthalene). Water with a sheen was found perched within the gravel drainfield at 9 to 12 feet bgs, but no free product was observed on the water. Accordingly, the petroleum discharged from the UIC outfall would be expected to contaminate the gravel within the drainfield, particularly near the source, and potentially migrate laterally on the water's surface to form residual contamination in the soils surrounding the drainfield within the zone of pit water fluctuation.

Although diesel, oil, and PAHs are not particularly soluble in water, surfactants may help to dissolve the contaminants. A water sample collected from a push probe installed at the drywell discharge location detected diesel, oil, PAHs, and toluene (however, this could be from the sheen that was observed on the sample rather than from dissolved constituents). Any chemicals that become dissolved in the pit water would be expected to migrate with this water as it percolates downward through the stiff silts of the Sand/Silt Unit to the uppermost groundwater at a depth of about 30 feet bgs. With respect to PAHs, because of their low solubility, they tend to migrate in the water attached to colloidal-sized particles, rather than in a dissolved state. Since diesel, oil, and PAHs tend to have an affinity for adhering to fine-grain soils and organic particles that are common in many alluvial soil types, it is expected that any contaminant levels (dissolved or colloidal) would attenuate rapidly.

Any contaminants that do reach the uppermost groundwater would then tend to migrate with the groundwater in the direction of flow, i.e. northerly towards the Willamette River. If any contaminants make it to uppermost groundwater, they would continue to attenuate as groundwater flows towards the river (550 feet away), eventually discharging to the Willamette River.

4.0 SITE CHARACTERIZATION

4.1 Investigation Objectives

The purpose of the subsurface investigation activities initiated in October 2003 was to determine the nature and extent of contamination that was

discovered at the drywell (UIC#1) outfall location, as well as to collect risk parameter data. The primary objectives of investigation activities were to:

- 1) Determine the size and extent of the gravel draintield
- 2) Determine if water in the gravel draintield is an isolated perched zone, or part of the regional groundwater system
- 3) Estimate groundwater flow direction using water level data from the existing Gunderson monitoring well network
- 4) Verify the site hydrogeological model, i.e. sand till (the Fill Unit) overlying native stiff silts (the Sand/Silt Unit) that may act to locally perch water above the expected regional water table at 27 to 30 feet bgs, as well as retard the migration of contaminants downward
- 5) Characterize the extent of residual soil contamination both within and outside the gravel draintield
- 6) Determine if impacts are present in the two water-bearing zones of concern, i.e. the gravel draintield water-bearing zone and the uppermost perennial groundwater within the Sand/Silt Unit of the Alluvial Deposits
- 7) Determine whether contaminants detected in a screening-level groundwater sample are representative of actual groundwater conditions, or were sampling-induced due to drilling and sampling methodology
- 8) Characterize the soils and groundwater for contaminants of interest and risk parameters
- 9) Gather other sufficient information to close UIC#1 under a risk-based approach.

In order to satisfy the above objectives two phases of subsurface investigation were conducted following the decommissioning of UIC#1. In October 2003, four push probe borings were installed at the site for the collection of soil samples and screening-level groundwater samples. In January and February 2004, two groundwater monitoring wells were installed at the property for the collection of representative groundwater samples.

4.2 Sampling Locations and Rationale

During the October 2003 investigative event, four push probe borings P-1 through P-4) were installed within and outside the gravel drainfield.

- Boring P-1 was installed to a depth of 30 feet bgs at the former drywell outfall location to evaluate the depth of the drainfield, the depth of soil impact, and to collect a "worst-case" screening-level perched water sample. Because of the size of the gravel in the drainfield, it was not possible to collect a soil sample of drainfield material.
- Boring P-2 (20 feet bgs) was installed 10 feet northeast of boring P-1 in attempt to determine the lateral extent of the drainfield and soil impact. No water samples were collected at this location.
- Borings P-3 and P-4 (20 feet bgs) were installed 34 feet northeast and 30 feet north, respectively, of boring P-1 to determine the lateral extent of the drainfield and soil impact. No water samples were collected at these locations.

Since groundwater impacts were detected in the screening-level perched water sample from boring P-1, it was deemed appropriate to conduct additional groundwater investigation. This investigation had two primary objectives: 1) to evaluate the groundwater quality of the two primary water-bearing zones at locations most likely to detect impacts, if present, and 2) to determine whether contaminants detected in the screening-level groundwater sample were sampling-induced. To fulfill the first objective, two monitoring wells (MW-1 and MW-2) were installed.

- MW-1 was installed at the worst-case drywell outfall location with a screen interval located across the lower drainfield gravels (7 to 12 feet bgs)
- MW-2 was installed in an inferred hydrogeological down-gradient location with respect to the drywell outfall and gravel drainfield, approximately 35 feet north of MW-1. The screen interval at MW-2 (22 to 32 feet bgs) was intended to span the uppermost perennial groundwater within the Alluvial Deposits throughout most seasonal fluctuations, with the goal of not placing the screen so deep that it would allow for dilution of any impacts that may be present. This well was placed in a location within the Sand/Silt Unit that would most-likely detect contamination from the former drywell, if present (i.e.

within uppermost perennial groundwater at a location immediately down-gradient of the draitfield).

To fulfill the second groundwater investigation objective, both monitoring wells were sampled by low-flow sampling techniques meant to reduce sampling-induced turbidity. Since site contaminants, particularly PAHs, tend to adhere to particulates, sampling-induced turbidity can overestimate the actual mobile contaminants in the groundwater.

4.3 Field Procedures

4.3.1 Push Probe Investigation

4.3.1.1 Drilling Procedures

On October 27, 2003, four push probe borings (P-1 through P-4) were installed at the subject site to depths ranging from 20 to 30 feet bgs. The locations of the push probe borings are shown on Figure 3. The borings were installed by Geo-Tech Explorations, Inc. of Tualatin, Oregon with a truck-mounted Geo-Probe Systems hydraulic hammer unit using 2-inch outside diameter (OD) hydraulically-driven steel rods. A perched water sample was collected from push probe boring P-1.

Following completion of the soil boring activities, the borings were backfilled with 3/4-inch bentonite chips to within 6 inches of the ground surface. Gravel was placed in the upper 6 inches of the boring to match the surrounding land surface.

All boring installation work was performed by an Oregon-bonded and licensed monitoring well constructor. The boring installations were completed in accordance with the Oregon Groundwater Law (Oregon Revised Statute (ORS) Chapter 537) and the Rules for Construction and Maintenance of Monitoring Wells and Other Holes in Oregon (Oregon Administrative Rules (OAR) Chapter 690, Division 240).

4.3.1.2 Soil Sampling and Screening Procedures

Continuous soil cores were collected using a 5-foot long, 2-inch OD Macro-Core Sampler. Discrete soil samples were selected from the cores for field screening and possible laboratory analyses based on field observation of soil type or contaminant occurrence. The properties of each soil core were

noted in the field by the HAI scientist. The push probe boring characteristics and observed soil types are recorded on boring logs (Appendix B).

Upon collection, each soil sample was immediately placed in a 4-ounce sample jar and capped with a teflon-lined lid. The sample jars were then labeled and transferred to a chilled container for shipment to the analytical laboratory. Standard sampling protocols, including the use of chain-of-custody documentation, were followed for all sampling procedures.

The soil samples were field-screened for the presence of potential contamination by the visual, olfactory, sheen test, and headspace vapor methods. The presence of sheen was assessed by placing clean tap water in a black pan and introducing approximately 5 grams of disaggregated soil to the water. Screening for the presence of organic vapors was conducted by the headspace method using a photoionization detector (PID) equipped with a 10.6 ev lamp. The results of the headspace screening are recorded on the boring logs (Appendix B) in parts per million (ppm). The headspace method results should be considered a qualitative indicator of possible contamination used for relative comparison purposes.

4.3.1.3 Screening-Level Water Sampling Procedures

A screening-level perched water sample was collected at one of the push probe borings (P-1) with a temporary well point. To collect the water samples, a 4-foot section of 1-inch OD, 0.004-inch slotted stainless steel well screen was pushed to beneath the suspected groundwater level. Water was detected at 8.5 feet bgs in P-1. The well screen interval was from 8-12 feet bgs.

The water sample was collected from a well point with new disposable bailer tubing following purging of approximately one liter of water with a vacuum pump. Sample containers were completely filled such that no headspace was present that would allow for the loss of volatiles. The sample containers were then labeled and transferred to a chilled container for shipment to the analytical laboratory.

4.3.2 Monitoring Well Installation and Sampling

4.3.2.1 Well Installation and Development

On January 19, 2004, HAI was on-site to oversee installation of monitoring wells MW-1 and MW-2. The monitoring wells were installed by Geo-Tech Explorations, Inc. with a Mobile B-59 drilling rig equipped with 6-inch inside diameter (ID), 10-inch OD, hollow-stem augers. The monitoring wells were constructed with 2-inch ID, threaded, schedule 40, polyvinyl chloride (PVC) blank casing and 0.010-inch slotted screen installed within an appropriate sand pack and well seal. The slotted screen was set from 7 to 12 feet bgs in MW-1, and from 22 to 32 feet bgs in MW-2. The sand pack was placed in the annular space from the bottom of the borehole to 1 foot above the top of the screen with Colorado 10/20 silica sand in MW-1, and 3 feet above the top of the screen in MW-2. The wells were developed with a surge block to set the sand pack. A well seal composed of 3/4-inch bentonite chips was placed on top of the sand pack and hydrated.

Each well was completed with an above-ground monument surrounded by three guard posts. The well casings were fitted with locking caps.

All monitoring well installation work was performed by an Oregon-bonded and licensed monitoring well constructor. The monitoring well installations will be completed in accordance with the Oregon Groundwater Law (ORS Chapter 537) and the Rules for Construction and Maintenance of Monitoring Wells and Other Holes in Oregon (OAR Chapter 690, Division 240).

Collection of continuous 1.5-foot long soil cores was attempted with a split-barrel sampling device to characterize the subsurface materials.

Soil samples were collected during monitoring well drilling activities at approximate 5-foot intervals using a split spoon sampler. The soil cores were screened in the field for visual, olfactory, sheen test, and headspace vapor methods.

Well logs documenting the characterization of subsurface materials and well construction details are presented in Appendix C.

On February 6, 2004, the wells were further developed by purging with a submersible pump in an attempt to remove the fine sediment from around the well bore. During development, at least 10 well volumes of water were

removed from each well. The parameters pH, temperature, conductivity, and turbidity were measured during the development process. Following purging, the wells were considered developed when the parameters had stabilized. Stabilization is considered to have been met when the last three measured values for each of the above parameters are within 10 percent of each other. Although stabilization was observed, the purge water remained turbid throughout the development process. Well development field logs are included in Appendix C.

4.3.2.2 Low-Flow Sampling

Low-flow sampling activities at the two monitoring wells were completed February 20, 2004. Low-flow sampling techniques purge water from each well at a low flow rate (less than one liter per minute) using a stainless steel bladder pump equipped with new polyethylene tubing. The pump intake was placed near the middle of the water column within the screened interval of all wells.

Stabilization parameter measurements were collected with use of a flow-through cell and an in-line multi-probe meter at approximate 2 to 5 minute intervals during purging. Parameter measurements recorded during purging were: time, purge volume, temperature, specific conductivity, dissolved oxygen (DO), pH, oxygen reduction potential (ORP), and turbidity. Water levels within the well were also measured during the purging process to monitor drawdown. The water level in MW-2 dropped below the top of the pump, not allowing measurement of this parameter during most of purging.

Purging continued until all parameters achieved the minimum stability criteria for three consecutive measurements, which was achieved at each well location. Stabilization criteria are established as readings within 10% for DO, ORP, and turbidity; within 3% for conductivity; within 0.1 pH unit; and within 10 millivolts for ORP.

Following the completion of purging, a representative groundwater sample was collected from each well with the bladder pump. All water samples were transferred into the appropriate sampling containers. The sample bottles were then labeled and transferred to a chilled container for shipment to the analytical laboratory.

Since at least three wells are needed within each water-bearing zone to determine groundwater flow direction, an elevation survey of the monitoring wells is not proposed at this time.

4.3.3 Decontamination Procedures

All reusable drilling and soil and groundwater sampling equipment was steam cleaned with potable water prior to use, and between boring locations, to prevent cross-contamination. All soil sampling equipment was decontaminated after each sample by using a detergent solution wash, and two potable water rinses. New disposable tubing was used for each groundwater sample. The Teflon bladder within the bladder pump, the only pump part that comes into contact with the water sample, was decontaminated before and after each sample by pumping a detergent solution wash and two deionized water rinses through the pump.

4.3.4 Investigative Derived Waste

Soil cuttings and soil sample waste generated during the *investigative* activities were incorporated into RAP pile for eventual reuse in asphalt. The drum of decontamination water is properly labeled and will be stored on-site in a secure area until it is transported off-site for proper disposal.

Decontamination water and well development purge water are stored in four 55-gallon drums, which were labeled and stored on-site in a secure area for later disposal and/or recycling.

4.4 Analytical Tests

The soil and groundwater samples were shipped with chain-of-custody documentation in sealed and chilled containers to Specialty Analytical located in Tualatin, Oregon.

4.4.1 Soil Analytical Tests and Rational

Based on field screening results, depth with respect to the water-bearing zones, and depth of the gravel drainfield, soil samples were selected from the push probe and well borings for analysis of one or more of the following parameters:

<u>Parameter</u>	<u>Analytical Method</u>
Hydrocarbon Identification (HCID) of Total Petroleum Hydrocarbons (TPH)	NW TPH-HCID
Diesel and Oil-Range TPH	NW TPH-Dx
Volatile Organic Compounds (VOCs)	EPA 8260B
Polynuclear Aromatic Hydrocarbons (PAHs)	EPA 8270 SIM
RCRA 8 Metals ^a (total basis)	EPA 6010/7471

^a - arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver

The results of the sludge and soil analytical testing are summarized on Table 1, while the laboratory reports and chain-of-custody documentation are included in Appendix D.

Testing by HCID was conducted on the sludge sample taken from the drywell outfall pipe to confirm that the types of petroleum hydrocarbons released were limited to diesel- and oil-range hydrocarbons. The sludge sample was also analyzed for PAHs, VOCs, and metals to characterize this material for disposal.

Analytical testing of the gravels within the drainfield was not practicable due to the size of the gravels (greater than 3-5 inches) and the lack of a matrix. Accordingly, the testing results for the sludge sample were utilized to estimate potential worst-case contamination of the drainfield gravels.

Since the HCID test identified only the presence of diesel- and oil-range hydrocarbons, all subsequently selected soil samples were analyzed for this range of hydrocarbons by NW Method TPH-Dx. The rationale for TPH characterization testing is presented below:

- Sample -003 (P-1 at 11.0-11.5 feet bgs) was selected for testing since it was collected in the native soils immediately below the drainfield gravels at the outfall location.
- Sample -004 (P-1 at 15.0-16.0 feet bgs) was selected for testing native silts that exhibited discoloration.
- Sample -008 (P-2 at 10.0-10.5 feet bgs) was selected for testing since it was collected in the native soils immediately below the gravels near the center of the drainfield.
- Sample -009 (P-2 at 10.5-11.5 feet bgs) was selected for testing to evaluate the vertical extent of petroleum hydrocarbons that were detected in sample -008.
- Sample -014 (P-3 at 13.0-13.5 feet bgs) was selected for testing native silts that exhibited discoloration.
- Sample -017 (P-4 at 8.0-8.5 feet bgs) was selected for testing the sample that exhibited the highest headspace vapor at this boring (in the Fill Unit).
- Sample -021 (MW-1 at 11.5-12.0 feet bgs) was selected for testing since it was collected in the native soils immediately below the drainfield gravels near the outfall location, as well as to test for risk parameters at this location.

Testing of the sludge sample by the TPH-Dx method was not conducted since it was not deemed necessary at the time for disposal of this material during UIC decommissioning (i.e. incorporation into the RAP pile).

Two soil samples were selected for follow-up testing for risk and characterization parameters (PAHs, VOCs, and metals).

- Sample -008 (P-2 at 10.0-10.5 feet bgs) was selected since this sample had the highest levels of TPH detected of any soil sample.

- Sample -021 (MW-1 at 11.5-12.0 feet bgs) was selected since it was collected near the source area (drywell outfall).

4.4.2 Groundwater *Analytical Tests and Rational*

Groundwater samples collected were analyzed for one or more of the following parameters:

<u>Parameter</u>	<u>Analytical Method</u>
Diesel and Oil-Range TPH	NW TPH-Dx
VOCs	EPA 8260B
PAHs	EPA 8270 SIM

The results of the groundwater analytical testing are summarized on Table 2, while the laboratory reports and chain-of-custody documentation are included in Appendix E.

The screening-level perched water sample collected at boring P-1 (8 to 12 feet bgs) was analyzed for the full suite of characterization and risk parameters (TPH, PAHs, and VOCs). Testing of the groundwater for metals was not deemed necessary since metals were not detected in sludge or soil at levels of concern.

The results of screening-level water testing at P-1 likely over-estimates actual chemical concentrations for two reasons:

- Since a sheen was present on the sample, the results may over-estimate actual dissolved concentrations (for TPH and VOCs particularly)
- Since the samples were turbid, the results may over-estimate the concentrations of chemicals that are mobile in the groundwater by colloidal transport (for PAHs particularly).

Thus screening-level water testing at P-1 testing should be considered worst-case and used in the following manner:

- If chemical concentrations are below risk screening values, then the results can be used to eliminate those chemicals from further evaluation

- If chemical concentrations are above risk screening values, then additional testing is warranted, and the screening-level results need not be used in further risk evaluation.

The low-flow groundwater samples collected from monitoring wells MW-1 and MW-2 were analyzed only for PAHs. Testing for VOCs was not deemed necessary, since the screening level sample at P-1 did not detect VOCs at levels of concern. Likewise, testing of the low-flow samples for TPH was not conducted since it was clear that risk screening levels were not established for the applicable exposure pathways at the property (see further discussion in Section xx).

4.5 Results and Discussion

4.5.1 Subsurface Conditions

The subsurface investigations confirmed the hydrogeological model that was presented in Sections 3.4.3 and 3.4.4. The Fill Unit composed of fine sand was found to be present to a depth of 10 to 10.5 feet bgs, which is underlain by the native Sand/Silt Unit, which is predominantly silt at this area of the site.

The gravel drainfield has dimensions of approximately 45 feet by 35 feet to depths of 10.5 to 11.5 feet bgs, overlying the native silts. At some locations within the drainfield, a 6-inch layer of sand is located below the gravel.

The underlying native Sand/Silt Unit is composed predominantly of silt with some clay and minor sand to a depth of approximately 36 feet bgs (MW-2), where a sand unit was encountered.

The groundwater investigation indicates that water is perched within the gravel drainfield at a depth of approximately 9 to 9.5 feet bgs (MW-1). The native silts immediately below the drainfield are described as soft and wet, but become stiff and damp within a few feet of depth. This suggests the silts are acting as a local confining or semi-confining layer, likely allowing only minor vertical flow through the unit. Outside of the drainfield, a very thin zone of possible perched water was observed at the base of the fill sands at a depth of approximately 10.5 feet bgs.

With depth the silts became wet again at about 26 feet bgs (MW-2), representing the top of the uppermost perennial groundwater within the

Alluvial Deposits beneath the site. The water levels later measured in MW-2 were found to be between 27 and 28 feet bgs, consistent with water levels found by Gunderson in their monitoring wells.

No attempt was made to determine groundwater flow direction since a northerly flow direction had already been established by Gunderson for this area of the site.

4.5.2 Soil Testing Results

Analytical testing of sludge and soil samples collected during site investigation and monitoring well installation activities conducted in 2003 and 2004 indicates diesel- and oil-type petroleum hydrocarbons were detected. Gasoline-type petroleum hydrocarbons were not detected above method detection limits.

Although discolored (olive gray) soils with a possible petroleum odor were observed in the native silts immediately below the gravel drainfield at the outfall location (P-1), soil samples collected from boring P-1 did not contain detectable levels of petroleum hydrocarbons at 11 or 15 feet bgs (Table 1).

In boring P-2, located approximately 10 feet northeast of the outfall, diesel- and oil-type petroleum hydrocarbons were detected at a total concentration of 1,065 ppm in the thin sand layer located at the base of the gravel drainfield (10.0-10.5 feet bgs). However, immediately below the sand layer in native discolored silts (10.5-11.0 feet bgs) at P-2, only 27.4 ppm diesel-type petroleum hydrocarbons were detected. Similarly, only 20 ppm diesel-type petroleum hydrocarbons were detected at boring MW-1 in the native discolored silty clay immediately below the gravel drainfield at this location.

Analytical results of soil samples collected from push probe borings installed outside and down-gradient of the gravel drainfield at 13 feet bgs in boring P-3 (a discolored silt zone) and from boring P-4 at 8.0 feet bgs (sand fill zone) did not detect diesel- or oil-type petroleum hydrocarbons above method detection limits.

Based on the preceding, it appears that the sample collected from the base of the drainfield at boring P-2 (1,056 ppm at 10.0-10.5 feet bgs) should be representative of the contamination that is present within the drainfield and coaming the large gravels that could not be tested. Although not entirely defined in a lateral sense, the residual soil impact appears to be limited to

the draitfield itself, as contamination was not observed or detected outside the draitfield. Vertically within the draitfield, the contamination would be present within the smear zone of seasonal perched water fluctuation (estimated to be 8 to 11 feet bgs), except at the outfall location where the gravels are coated with petroleum beginning at a depth of 4.5 feet bgs. Furthermore, based on direct testing of the native silts immediately below the draitfield at borings P-1, P-2, and MW-1, the residual petroleum impact in soil attenuates very rapidly declining to less than 30 ppm within one foot.

Finally, the frothy sludge that was observed and tested within the outfall pipe was only seen in soils directly beneath the drywell discharge location, and not in other areas of the draitfield. Accordingly, although the sludge was removed, the testing of petroleum constituents and risk parameters for the sludge sample can be used as a "worst-case" sample for the petroleum impacted soils in the draitfield.

Testing for VOCs, PAHs, and total metals was conducted on three samples that should be representative of their respective soil units: 1) the sludge sample which should be worst-case for the gravels at the outfall location; 2) the 10-foot bgs sample at P-2, which detected the highest levels of petroleum hydrocarbons at the site (1,065 ppm), and should be representative of draitfield contamination away from the outfall; and 3) the 11.5-foot sample at MW-1 which should be representative of impacts within the native silt unit below the draitfield.

VOCs were not detected in the three referenced samples, except for a low level of naphthalene (0.628 ppm) in the sludge sample and a low level of methylene chloride in the P-2 sample that is attributed to laboratory contamination (Table 1). PAHs were detected in both draitfield samples (sludge and P-2), but not in the sample of native silts (MW-1). The only PAH that was detected at a concentration above a non-residential risk-based screening level (i.e. DEQ Risk-Based Concentrations) was benzo(a)pyrene (0.317 ppm) in the sludge sample, the significance of which will be discussed in Section 4.4.1.

Although metals were detected in the three referenced samples, none were found at levels of concern (i.e. at concentrations above default background levels as determined by DEQ) (Table 1). Although, the testing results for the soil sample collected at 11.5 feet bgs at MW-1 indicates arsenic was detected at 7.55 ppm, which is slightly above the DEQ default background concentration is 7.0 ppm, the detected concentration is within the range of

naturally-occurring levels and was not detected in the other two samples. Additionally, arsenic is not a contaminant of interest at the site.

4.5.3 Groundwater Testing Results

Three groundwater samples have been collected at the site as part of the UIC investigation:

- 1) Screening-level sample taken from push probe boring P-1 of perched water within the drainfield
- 2) Samples from developed monitoring wells
 - a) Sample from MW-1 of perched water within the drainfield
 - b) Sample from MW-2 of uppermost groundwater within the native Alluvial Deposits immediately down-gradient of the drainfield.

Analytical testing of the screening-level water sample obtained from boring P-1 indicates diesel-type petroleum hydrocarbons were detected at 14,600 parts per billion (ppb), which is above DEQ's most conservative Risk-Based Concentration (RBC) for non-residential exposure pathways of 350 ppb. In addition, 6,850 ppb oil-range petroleum hydrocarbons were detected in the same sample. The laboratory report indicates the oil-range hydrocarbons in this sample are biased due to a high amount of diesel contained in the sample. This information suggests the petroleum hydrocarbons are from diesel-type petroleum hydrocarbons, and are not necessarily a measurement of oil-type petroleum hydrocarbons.

Analytical testing of the screening-level water sample obtained from boring P-1 indicates VOCs were not detected above method detection limits, excepting the detection of 2.73 ppb toluene (Table 2), which is below non-residential and ecological risk screening levels.

As previously discussed, the screening level sample from P-1, due to sampling induced turbidity, will over-estimate contaminants in the groundwater that are relatively insoluble and tend to adhere to soil particles, such as PAHs. This is borne out by comparing the total PAHs detected in the water sample from P-1 [6.48 parts per billion (ppb)], and total PAHs detected in the water sample from monitoring well MW-1 (0.49 ppb), which was screened at the same location and depth as P-1. Accordingly, the water testing results from boring P-1 are not representative of dissolved or mobile PAHs in groundwater, and will not be used for risk evaluation purposes.

The PAHs acenaphthylene (0.057 ppb), fluorene (0.352 ppb), and pyrene (0.076 ppb) were detected in the perched water sample from well MW-1, but none at concentrations exceeding non-residential or ecological risk screening levels. PAHs were not detected in the groundwater sample collected at MW-2 from the uppermost groundwater in the Alluvial Deposits immediately down-gradient of the drainfield.

The lack of detectable contaminants (PAHs) in the sample collected at the location most-likely to detect contamination if it was present in the uppermost groundwater of the Alluvial Deposits (i.e. at MW-2 immediately down-gradient of the gravel drainfield), indicates that impacts to groundwater are limited to the perched water that is present within the drainfield.

5.0 BENEFICIAL USE EVALUATION

5.1 Reasonably Likely Land-Use

The subject property, as well as all adjacent properties, are located in an area used for industrial purposes. As depicted on the zoning map provided within Appendix F, the subject property and surrounding properties are zoned Heavy Industrial (IHi or IH) by the City of Portland. According to the City of Portland, Bureau of Planning (Appendix F), the zone provides areas where all kinds of industries may locate including those not desirable in other zones due to their objectionable impacts or appearance. Furthermore, the subject property lies within a designated "Industrial Sanctuary" zone dedicated to long-term industrial use. Therefore, the current and reasonably-likely future land use for the site is considered to be "industrial".

5.2 Reasonably Likely Beneficial Use of Groundwater

Currently, tap water at the subject property and adjoining properties is supplied by the City of Portland municipal water system. No water wells are present on the subject property. Given the historical presence of municipal water service for this area of Portland, it is unlikely that any water wells are in use by nearby properties for domestic purposes. According to the property owner, groundwater at the site is not expected to be used for drinking water in the future.

HAI conducted a water well inventory for the area within a one-half-mile radius of the site to determine the usage of groundwater. The well inventory

was based on well logs filed with the Oregon Water Resources Department (OWRD). The search of the OWRD well log database was conducted using the OWRD's Web-based GRID query. A door-to-door survey was not conducted to identify undocumented water wells. Results of the well survey query indicated the presence of only one water well within one-half-mile of the site, and no wells used for domestic purposes.

The identified water well, located approximately 1/4 mile west of the Lakeside Industries property, was installed for industrial purposes by Chevron in 1989. The well is an open-hole completion within the Columbia River Basalt aquifer between the depths of 81 and 310 feet bgs. It is not known if the well is currently in use.

Because of the availability of municipal water in Portland, as well as the lack of any current trends towards development of groundwater for domestic or industrial purposes in the area, it is concluded there is no reasonably-likely current or future use of groundwater for domestic use within 1/2-mile of the subject site.

Based on the preceding, the use of groundwater as a drinking water source will not be carried forward in the risk evaluation (Section 6.0).

6.0 RISK EVALUATION

Since all the contaminants of potential concern at UIC#1 are petroleum-related, a risk evaluation was conducted for the site according to DEQ's Risk-Based Decision Making (RBDM) guidance document (DEQ 2003) to determine potential human health risks relating to the former UIC at the property (Section 6.1). Although based on empirical results and the conceptual fate and transport model, which indicate that UIC#1 contamination will not migrate to the Willamette River, as a conservative measure, a risk-screening was conducted against ecological risk screening level values (Section 6.2).

6.1 Human Health Risk Evaluation

6.1.1 Conceptual Site Exposure Model

The conceptual site exposure model describes the migration pathways and exposure scenarios (potentially exposed populations and exposure routes)

through which humans may be exposed to contaminants of potential concern at the site. No exposure, and thus no potential for risk, exists unless an exposure pathway is complete. The site exposure model presented herein is based on the identified soil and groundwater conditions, as well as current and reasonably-likely future land uses and beneficial uses of groundwater within the locality of the site.

6.1.1.1 Contaminant Sources and Exposure Media

The release mechanism at the site relates to historical releases of predominantly diesel-type petroleum hydrocarbons from surface water runoff collected from a diesel fueling area, a soaping area, and a former wash rack that entered the stormwater collection system, passed through an oil/water separator, and discharged to a gravel drainfield (UIC#1).

Site investigation activities indicate the impacts to soil are primarily limited to the gravel drainfield between depths of 4.5 and 12 feet bgs. Likewise, impacts to water are limited to the perched water within the drainfield typically between depths of 8 and 12 feet bgs.

Based on the analytical testing results, the only chemical found in soil at a concentration that exceeds most-conservative non-residential risk screening levels (RBCs) is benzo(a)pyrene. The only contaminant found in groundwater at a concentration that exceeds most-conservative non-residential risk screening levels (RBCs) is diesel-range TPH. However, as a conservative measure contaminants of potential concern to be included in the risk evaluation will include all detected VOCs, PAHs, and diesel-range TPH.

For purposes of this risk evaluation, the identified exposure media are subsurface soil and groundwater and the contaminants of potential concern are detected VOCs, PAHs, and diesel-range TPH.

6.1.1.2 Exposure Pathway Analysis

Eight exposure pathways for soil and groundwater, as outlined in the DEQ RBDM guidance document (DEQ 2003), were evaluated for applicability to the site, including:

Soil

- 1) Surface soil ingestion, dermal contact, and inhalation
- 2) Volatilization to outdoor air
- 3) Vapor intrusion into buildings
- 4) Leaching to groundwater

Groundwater

- 5) Ingestion and inhalation from tap water
- 6) Volatilization to outdoor air
- 7) Vapor intrusion into buildings
- 8) Groundwater in excavation

Table 3 lists the various exposure pathways/receptor scenarios that were evaluated for the site, and briefly explains the rationale for the selection or exclusion of each exposure pathway. The following exposure pathways were eliminated:

- All residential receptor scenarios were eliminated since the beneficial land use evaluation indicates residential use of the property and surrounding area is not reasonably likely
- All exposure pathways involving groundwater ingestion were eliminated since the beneficial water use evaluation indicates current and future groundwater use for domestic or consumptive purposes in the area is not reasonably likely
- Because the depth of soil impact (greater than 4.5 feet bgs) is greater than the 3-foot bgs cutoff for surface soil exposure, the surface soil exposure pathways were eliminated from further consideration.
- Although all exposure pathways involving vapor intrusion into buildings could be eliminated since the impacts are not within 10 feet

of any building, this pathway will be retained to evaluate potential risk to future structures.

As shown in Table 3, the following six exposure pathways/receptor scenarios were retained for further evaluation:

Soil

- 1) Soil ingestion, dermal contact, and inhalation by an excavation worker
- 2) Volatilization to outdoor air for an occupational receptor
- 3) Vapor intrusion into buildings for an occupational receptor

Groundwater

- 4) Groundwater volatilization to outdoor air for an occupational receptor
- 5) Groundwater vapor intrusion into buildings for an occupational receptor
- 6) Groundwater in an excavation for an excavation worker.

6.1.2 Risk Characterization

The evaluation of potential unacceptable risks at the site was conducted by comparing the maximum detected concentration for each COPC (contaminant of potential concern) to the applicable RBCs for each of the six exposure pathways/receptor scenarios identified for the site. Use of the maximum detected concentration at the site provides for a conservative evaluation against the RBCs. As discussed earlier, PAH testing results for the screening-level water sample from boring P-1 were not used in this evaluation. The results of this comparison are shown on Table 4.

The maximum detected concentrations of COPCs in soil and groundwater samples were all found to be less than the applicable RBCs, based on current and reasonably likely potential exposure pathways.

In conclusion, the risk evaluation did not identify the presence of current or reasonably likely future unacceptable risks to human health resulting from the documented petroleum impacts to soil and perched water relating to the former UIC#1 at the subject property.

While the diesel-type petroleum hydrocarbons present in soil are at concentrations below DEQ Risk-Based Concentrations, if left in-place, no actions are necessary with respect to the impacted soils. However, if the

petroleum-contaminated soil is encountered during future site development activities, special management of the soil will be necessary for removal and/or disposal purposes.

Should impacted groundwater (i.e., containing a sheen) be encountered during future site development activities, proper management of the removal and disposal of this water will be necessary.

Further evaluation of impacts at UIC#1 do not appear necessary, and administrative closure of this UIC appears warranted.

6.2 Ecological Risk Screening Evaluation

Since the site is located adjacent to the boundaries of the Portland Harbor Superfund Site, petroleum hydrocarbon constituents (PAHs and VOCs) in groundwater samples were compared to lowest DEQ Ecological Level II Screening Level Values (SLVs) for fresh surface water aquatic receptors (Table 2). As previously discussed, PAH testing results for the screening-level water sample from boring P-1 were not used in this evaluation.

The ecological risk screening evaluation reveals that the maximum detected concentrations of COPCs in groundwater samples were all found to be less than the lowest DEQ SLVs.

Although the method detection limit for benzo(a)anthracene (0.048 ppb) was above the lowest DEQ SLV (0.027 ppb) in the groundwater samples from MW-1 and MW-2, this chemical was not detected in either sample. Since the samples were analyzed by the low-level single-ion method (SIM), this is deemed to be the lowest achievable detection limit, and further evaluation of benzo(a)anthracene in groundwater is not warranted.

In conclusion, the ecological SLV evaluation did not identify the potential for unacceptable risks to aquatic receptors in surface water resulting from the petroleum impacts at former UIC#1.

7.0 LIMITATIONS AND SIGNATURES

The information presented in this report was collected, analyzed, and interpreted following the standards of care, skill, and diligence ordinarily provided by a professional in the performance of similar services as of the time the services were performed. This report and the conclusions and/or recommendations contained in it are based solely upon research and/or observations, and physical sampling and analytical activities that were conducted.

The information presented in this report is based only upon activities witnessed by HAI or its contractors, and/or upon information provided to HAI by the Client and/or its contractors. The analytical data presented in this report document only the concentrations of the target analytes in the particular sample, and not the property as a whole.

Unless otherwise specified in writing, this report has been prepared solely for the use by the Client and for use only in connection with the evaluation of the subject property. Any other use by the Client or any use by any other person shall be at the user's sole risk, and HAI shall have neither liability nor responsibility with respect to such use.

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9.0 GLOSSARY OF ABBREVIATIONS

AST	above ground storage tank
bgs	below existing ground surface
BTEX	benzene, toluene, ethylbenzene, xylene
DEQ	Oregon Department of Environmental Quality
EPA	U.S. Environmental Protection Agency
Gunderson	Gunderson, Inc.
HAI	Hahn and Associates, Inc.
HCID	hydrocarbon identification
HVOCs	halogenated volatile organic compounds
ID	inner diameter
Lakeside	Lakeside Industries, Inc.
LUST	leaking underground storage tank
msl	mean sea level
NW	Northwest
OAR	Oregon Administrative Rules
OD	outer diameter
ORS	Oregon Revised Statutes
OWRD	Oregon Water Resources Department
PAHs	polynuclear aromatic hydrocarbons
ppb	parts per billion
ppm	parts per million
Portland Harbor	Portland Harbor Superfund Site
PRG	EPA Region 9 Preliminary Remedial Goal
PVC	polyvinyl chloride
RAP	recycled asphalt pavement
RBC	DEQ Risk Based Concentration
SLV	DEQ Ecological Level II Screening Level Value
TPH	total petroleum hydrocarbons
UIC	underground injection control
UST	underground storage tank
VOCs	volatile organic compounds

TABLE 2 – Summary of Groundwater Testing Results

Analytical Parameters	Analytical Testing Results in ug/L (ppb)			Reference Levels in ug/L (ppb)	
	P-1	MW-1	MW-2	Non-Residential DEQ RBC ²	Ecological DEQ SLVs ³
Sample Location ==>					
Sample Number ¹ ==>	031027-101	040220-203	040220-201		
Sample Date ==>	27-Oct-03	20-Feb-04	20-Feb-04		
Screen Interval (feet bgs) ==>	8 - 12	7 - 12	22 - 32		
Petroleum Hydrocarbons by NW Method TPH-Dx					
Diesel-Range	14,600.			350.	
Oil-Range	5,850. ⁴				
Diesel + Oil	21,450.				
Volatile Organic Compounds (VOCs) by EPA 8260					
Benzene	0.4 U			2.2	130.
Toluene	2.73			2,900.	9.8
Ethylbenzene	1. U			5,400.	7.3
Total Xylenes	2. U			820.	13.
Naphthalene	1. U			25.	620.
Other VOCs	U				
Polynuclear Aromatic Hydrocarbons (PAHs) by EPA Method 8270SIM					
Acenaphthene	0.927	0.0476 U	0.0478 U	1,500.	520.
Acenaphthylene	0.0504 U	0.0571	0.0478 U		
Anthracene	0.353	0.0476 U	0.0478 U	7,300.	13.
Benzo(a)anthracene	0.192	0.0476 U	0.0478 U	0.56	0.027
Benzo(a)pyrene	0.272	0.0476 U	0.0478 U	0.056	0.014
Benzo(b)fluoranthene	0.464	0.0476 U	0.0478 U	0.56	
Benzo(g,h,i)perylene	0.151	0.0476 U	0.0478 U		
Benzo(k)fluoranthene	0.171	0.0476 U	0.0478 U	5.6	
Chrysene	0.292	0.0476 U	0.0478 U	56.	
Dibenzo(a,h)anthracene	0.0605	0.0476 U	0.0478 U	0.056	
Fluoranthene	0.302	0.0476 U	0.0478 U	5,800.	6.16
Fluorene	0.474	0.352	0.0478 U	970.	3.9
Indeno(1,2,3-cd)pyrene	0.101	0.0476 U	0.0478 U	0.56	
Naphthalene	0.0504 U	0.0476 U	0.0478 U	25.	620.
Phenanthrene	0.575	0.0476 U	0.0478 U		6.3
Pyrene	2.15	0.0761	0.0478 U	4,400.	
Total PAHs	6.48	0.49	U		

Note: 1 = Sample Number Prefix: 6235-

2 = Based on lowest DEQ Non-Residential Risk-Based Concentration (RBC), September 2003, unless otherwise indicated

3 = DEQ lowest Ecological Level II Screening Level Values (SLVs) for fresh surface water receptors

4 = Oil results are biased high due to amount of diesel contained in the sample

Bold = Concentration exceeds Reference Level

bgs = below ground surface

DEQ = Oregon Department of Environmental Quality

EPA = U.S. Environmental Protection Agency

ppb = parts per billion

U = not detected above concentration indicated

ug/l = micrograms/liter

VOCs = volatile organic compounds

TABLE 1 - Summary of Sludge and Soil Testing Results: UIC#1

Analytical Parameters	Analytical Testing Results mg/kg (ppm)								Reference Levels mg/kg (ppm)	
	UIC#1 Sludge	P-1	P-2	P-3	P-4	MW-1	Lowest DEQ RBC ¹	DEQ Default Background Concentration ²		
Sample Location ==>	6235-030930-001	6235-031027-003	6235-031027-004	6235-031027-008	6235-031027-009	6235-031027-014	6235-031027-017	6235-040119-021	Non-Residential	
Sample Number ==>	30-Sep-03	77-Oct-03	27-Oct-03	27-Oct-03	27-Oct-03	27-Oct-03	27-Oct-03	19-Jan-04		
Sample Date ==>	30-Sep-03	77-Oct-03	27-Oct-03	27-Oct-03	27-Oct-03	27-Oct-03	27-Oct-03	19-Jan-04		
Depth (feet bgs) ==>	In Pipe	11.0 - 11.5	15.0 - 16.0	10.0 - 10.5	10.5 - 11.5	13.0 - 13.5	8.0 - 8.5	11.5 - 12.0		
Petroleum Hydrocarbons by NW Method TPH-HCID or TPH-Dx										
Gasoline-Range	20. U	25.7 U							110.	
Diesel-Range	Detect	19.3 U	20.2 U	853.	27.4	19.8 U	16.3 U	20.	23,000.	
Oil-Range	Detect	64.3 U	67.4 U	212. *	65.9 U	66.1 U	54.4 U	65.4 U		
Diesel + Oil		U	U	1,065.	27.4	U	U	20		
Volatile Organic Compounds (VOCs) by EPA 8260										
Benzene	0.5 U			0.01 U				0.01 U	0.052	
Toluene	0.5 U			0.01 U				0.01 U	180.	
Ethylbenzene	0.5 U			0.01 U				0.01 U	28,000.	
Total Xylenes	1. U			0.02 U				0.02 U	100.	
Naphthalene	0.628			0.01 U				0.01 U	15.	
Other VOCs	U			0.0561 *				U		
Polynuclear Aromatic Hydrocarbons (PAHs) by EPA Method 8270 SIM										
Acenaphthene	1.78			0.026				0.0067 U	16,000	
Acenaphthylene	0.417			0.0067 U				0.0067 U		
Anthracene	4.4			0.0707				0.0067 U	90,000.	
Benzo (a) anthracene	0.317			0.0147				0.0067 U	2.7	
Benzo (a) pyrene	0.317			0.0153				0.0067 U	0.27	
Benzo (b) fluoranthene	0.583			0.0213				0.0067 U	2.7	
Benzo (ghi) perylene	0.2			0.0093				0.0067 U		
Benzo (k) fluoranthene	0.167 U			0.0073				0.0067 U	27.	
Chrysene	0.417			0.018				0.0067 U	270	
Dibenzo (a,h) anthracene	0.167 U			0.0067 U				0.0057 U	0.27	
Fluoranthene	0.85			0.0433				0.0067 U	8,900.	
Fluorene	8.			0.131				0.0067 U	12,000.	
Indeno (1,2,3-cd) pyrene	0.167 U			0.0067 U				0.0067 U	2.7	
Naphthalene	0.55			0.0067 U				0.0057 U	15.	
Phenanthrene	14.4			0.336				0.0067 U		
Pyrene	5.75			0.0847				0.0067 U	6,700.	
Total PAHs	38			0.78				U		
Total Metals by EPA Method 6010/7471										
Arsenic	1.79 U			1.67 U				7.55	1.6 ³	
Barium	87.4			75.4				163.	67,000. ³	
Cadmium	0.366			0.0833 U				0.0926 U	450. ³	
Chromium	12.6			12.				16.9	64. ³	
Lead	1.79 U			1.67 U				1.85 U	30.	
Mercury	0.232			0.0132 U				0.0216	62. ³	
Selenium	1.79 U			1.67				1.85 U	5,100.	
Silver	1.79 U			1.67				1.85 U	5,100. ³	

Note: bgs = below ground surface
 DEQ = Oregon Department of Environmental Quality
 EPA = U.S. Environmental Protection Agency
 HCID = hydrocarbon identification

mg/kg = milligram/kilogram
 ppm = parts per million
 U = not detected above concentration indicated
 TPH = total petroleum hydrocarbons

1 = DEQ Risk Based Concentration (RBC), September 22, 2002.
 2 = DEQ Default Background Concentrations for Metals memo, October 28, 2002.
 3 = EPA Region 9 Preliminary Remedial Goal (PRG), October 2002.
 4 = Oil results are biased high due to amount of diesel contained in the sample
 5 = Detected methylene chloride concentration of 0.0561 ppm is attributed to laboratory contamination
 Bold = Concentration exceeds Reference Level and Default Background Concentration, if applicable

TABLE 3 – Conceptual Site Exposure Model

Medium	Exposure Pathway	Receptor Scenario	Pathway Retained	Rational
Soil	Soil Ingestion, Dermal Contact, and Inhalation	Residential / Urban Residential	No	Residential land use is not reasonably-likely
		Occupational	No	Soil impacts are below 4.5 feet bgs
		Construction Worker	No	Soil impacts are below 4.5 feet bgs
		Excavation Worker	Yes	Soil impacts are present within the depths of potential excavation activities
	Volatilization to Outdoor Air	Residential / Urban Residential	No	Residential land use is not reasonably-likely
		Occupational	Yes	Impacted soils are present within the vadose beneath the site
	Vapor Intrusion into Buildings	Residential / Urban Residential	No	Residential land use is not reasonably-likely
		Occupational	Yes	Although impacted soils are not present near a site structure, this pathway is retained as a conservative measure for potential future structures
	Leaching to Groundwater	Residential / Urban Residential	No	Residential land use is not reasonably-likely
		Occupational	No	Use of groundwater for consumptive purposes is not reasonable likely
Groundwater	Groundwater Ingestion and Inhalation	Residential / Urban Residential	No	Use of groundwater for drinking or bathing purposes is not reasonably-likely
		Occupational	No	Use of groundwater for drinking or bathing purposes is not reasonably-likely
	Groundwater Volatilization to Outdoor Air	Residential / Urban Residential	No	Residential land use is not reasonably-likely
		Occupational	Yes	Groundwater impacts are present beneath the site
	Groundwater Vapor Intrusion to Buildings	Residential / Urban Residential	No	Residential land use is not reasonably-likely
		Occupational	Yes	Although impacted groundwater is not present near a site structure, this pathway is retained as a conservative measure for potential future structures
	Groundwater in Excavation	Construction and Excavation Worker	Yes	Excavation to the depth of perched water at 8 feet bgs is possible

Note: bgs = below ground surface

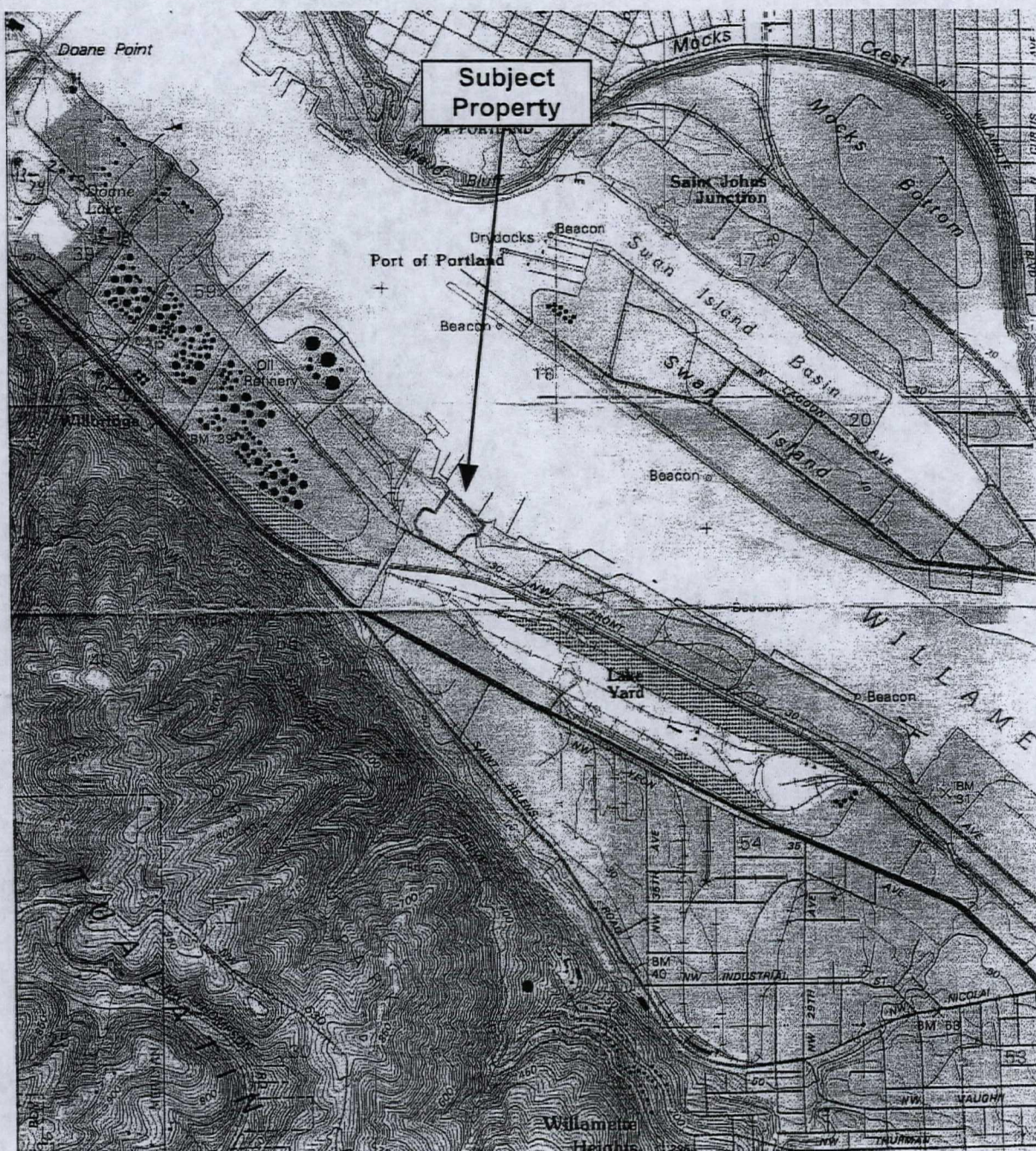
TABLE 4 – Risk Evaluation for Soil and Groundwater

SOIL	DEQ Risk-Based Concentration (RBC) for Soil – mg/kg (ppm)			Maximum Detected Concentration in Soil mg/kg (ppm)	Comparison to Risk-Based Concentration
	Exposure Pathway ==>	Surface Soil Ingestion, Dermal Contact, and Inhalation	Volatilization to Outdoor Air	Vapor Intrusion into Buildings	
	Receptor Scenario ==>	Excavation Worker	Occupational	Occupational	
Contaminant of Potential Concern					
Generic Diesel	-	-	-	1,065.	Below
Acenaphthene	-	-	-	1.78	Below
Anthracene	-	-	-	4.4	Below
Benzo[a]anthracene	-	590.	-	0.317	Below
Benzo[a]pyrene	-	59.	-	0.317	Below
Benzo[b]fluoranthene	-	590.	-	0.583	Below
Benzo[k]fluoranthene	-	5,900.	-	0.007	Below
Chrysene	-	59,000.	-	0.417	Below
Fluoranthene	-	-	-	0.85	Below
Fluorene	-	-	-	8.	Below
Naphthalene	-	20,000.	-	0.628	Below
Pyrene	-	-	-	5.75	Below

GROUNDWATER	DEQ RBC for Groundwater – ug/L (ppb)			Maximum Detected Concentration in Groundwater ug/L (ppb)	Comparison to Risk-Based Concentration
	Exposure Pathway ==>	Volatilization to Outdoor Air	Vapor Intrusion into Buildings	Groundwater in Excavation	
	Receptor Scenario ==>	Occupational	Occupational	Construction & Excavation Worker	
Contaminant of Potential Concern					
Generic Diesel	-	-	-	21,450.	Below
Toluene	-	-	-	78,000.	Below
Fluorene	-	-	-	0.352	Below
Pyrene	-	-	-	0.076	Below

Note: - = RBC not established
 mg/kg = milligrams per kilogram
 ppb = parts per billion

ppm = parts per million
 U = not detected above detection limit indicated
 ug/L = micrograms per liter



Note: Base Map from the Portland, Oregon (1990)
USGS 7.5-Minute Quadrangle
Contour Interval: 10 Feet



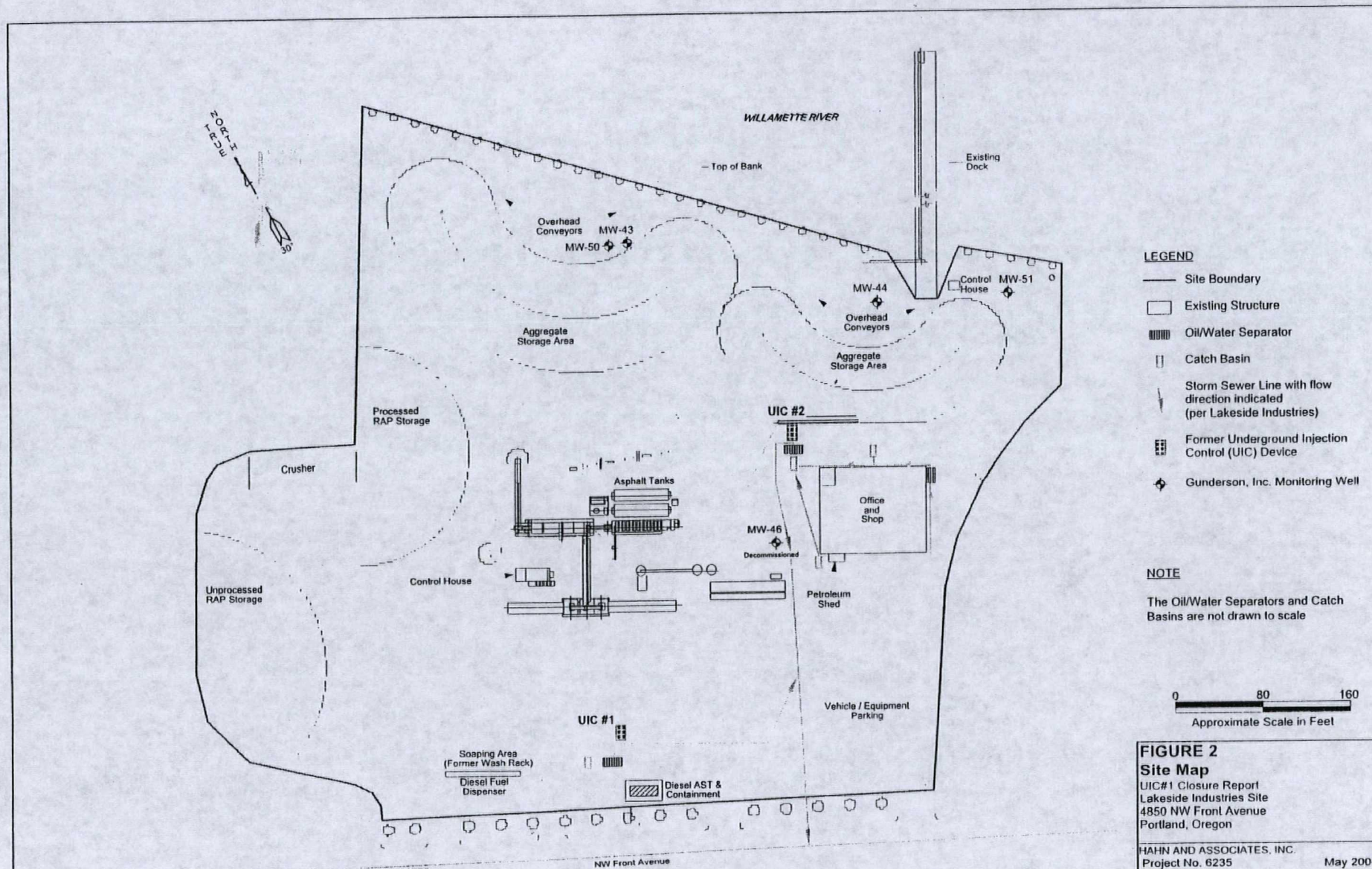
0 2000 4000
Scale in Feet

FIGURE 1 Location Map

UIC #1 Closure Report
Lakeside Industries
4850 NW Front Avenue
Portland, Oregon

HAHN AND ASSOCIATES, INC.
Project No. 6235

May 2004



Note: Site Plan is from Smith Monroe & Gray Engineers, Inc., Beaverton, Oregon 1988

File: 6235-02 Site Map

